CoSPA
0 to 8 Hour Storm Prediction for Aviation

Update

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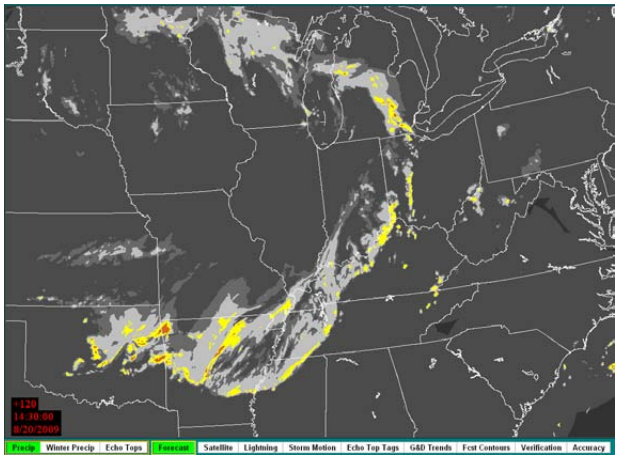
MIT Lincoln Laboratory

22 March 2010

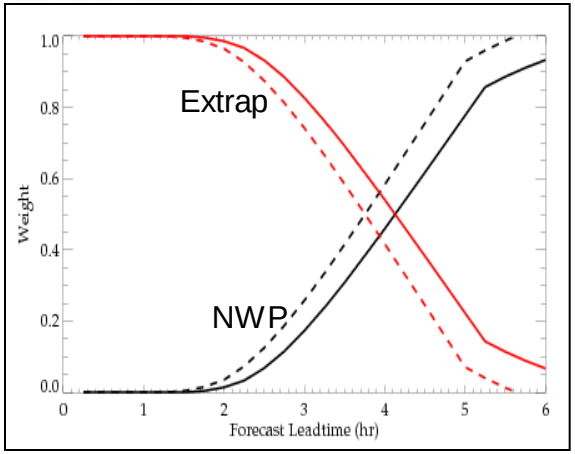
CoSPA 0-8 Hour Forecast
Main Components

Corridor Integrated Weather System (CIWS)

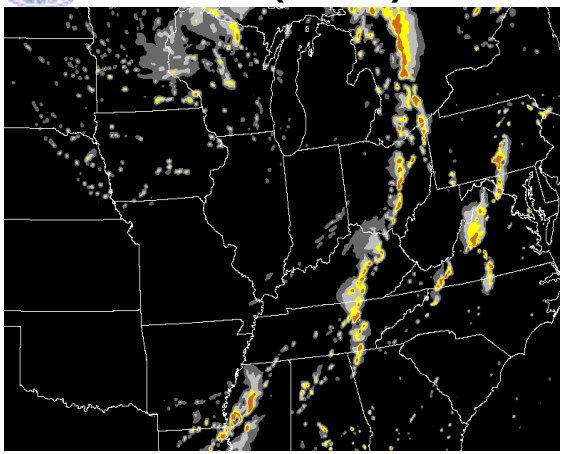


Extrapolation

Blending Module



High Resolution Rapid Refresh (HRRR)



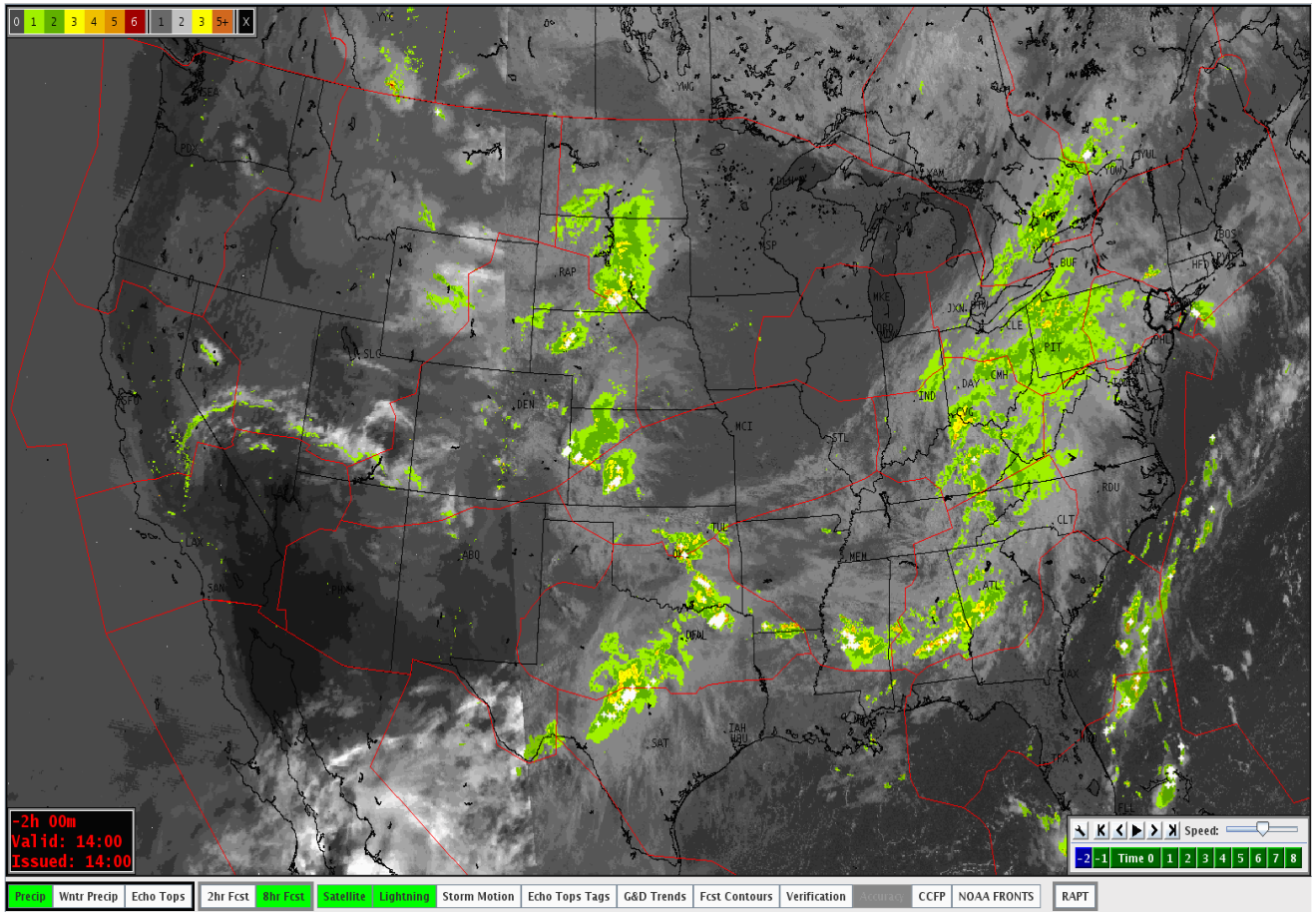
Numerical Weather Prediction

0 Hour → Forecast Lead → 8 Hour

Air Traffic Management (ATM) Planning

- **'Tactical' Planning (0-2hr)**
- **'Strategic' Planning (2-8hr)**

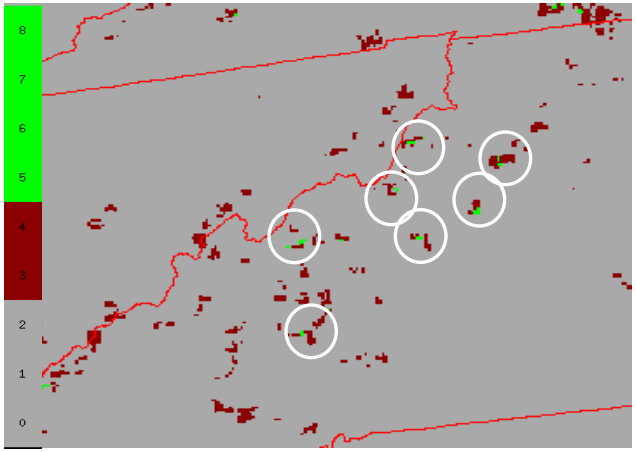
CoSPA Situation Display



- Horizontal resolution:1 km (0-2 hour), 3 km (2-8 hr)
- CONUS coverage
- Display 2D VIL and ET
- Forecast out to 8 hours
- Time steps: 5 min (0-2 hr), 15 min (2-8 hr)
- Deterministic forecast (Probabilistic forecast under development)

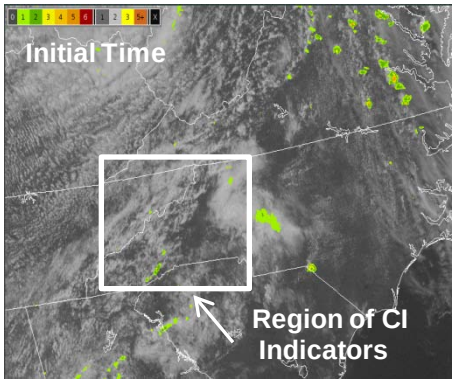
CoSPA Research
Convective Initiation

Eight Satellite CI Indicators

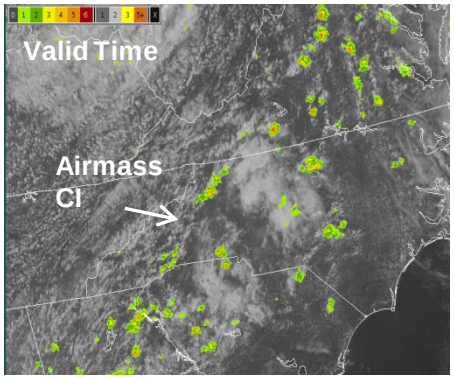


- SATCAST running in real-time CoSPA testing environment
- Algorithms being designed and tested to use SATCAST in CoSPA
- SATCAST data being sent to NCAR and NOAA ESRL for their research

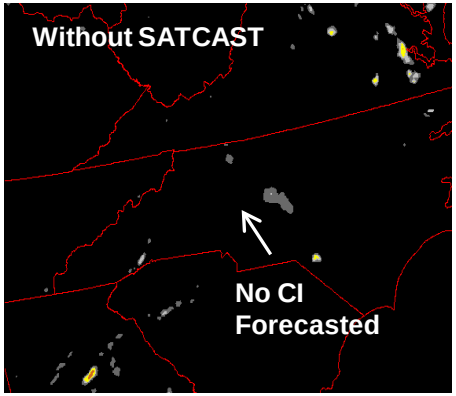
Radar Precipitation & Satellite



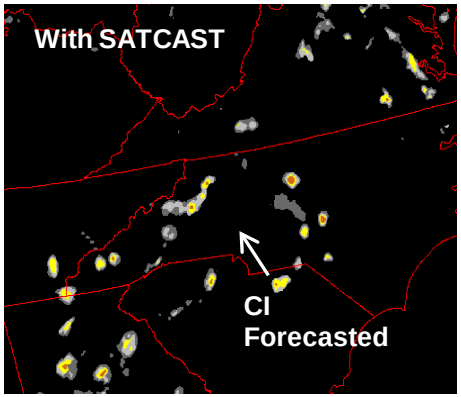
Radar Precipitation & Satellite



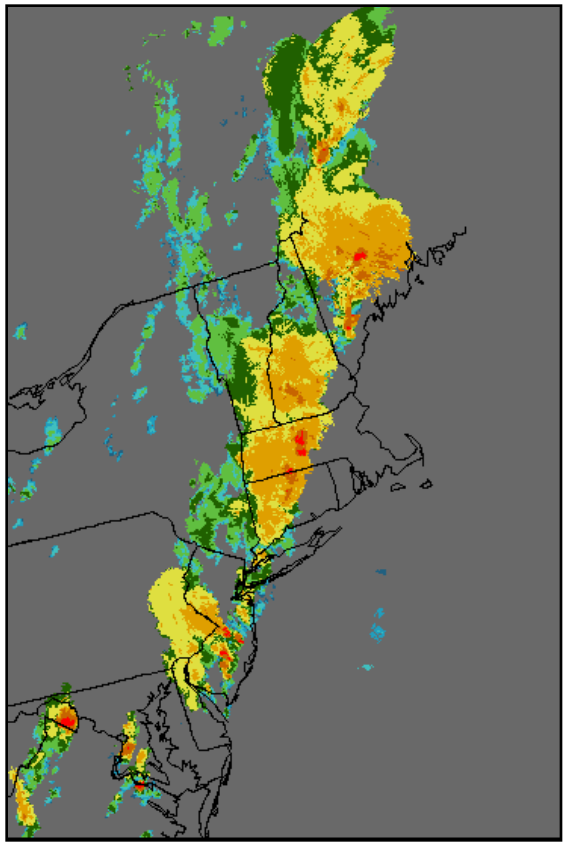
1 Hour Precipitation Forecast



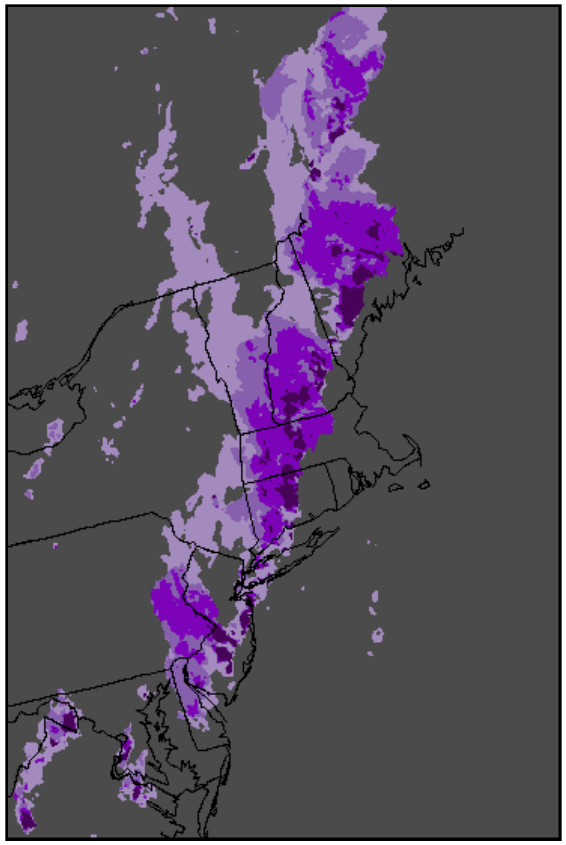
1 Hour Precipitation Forecast



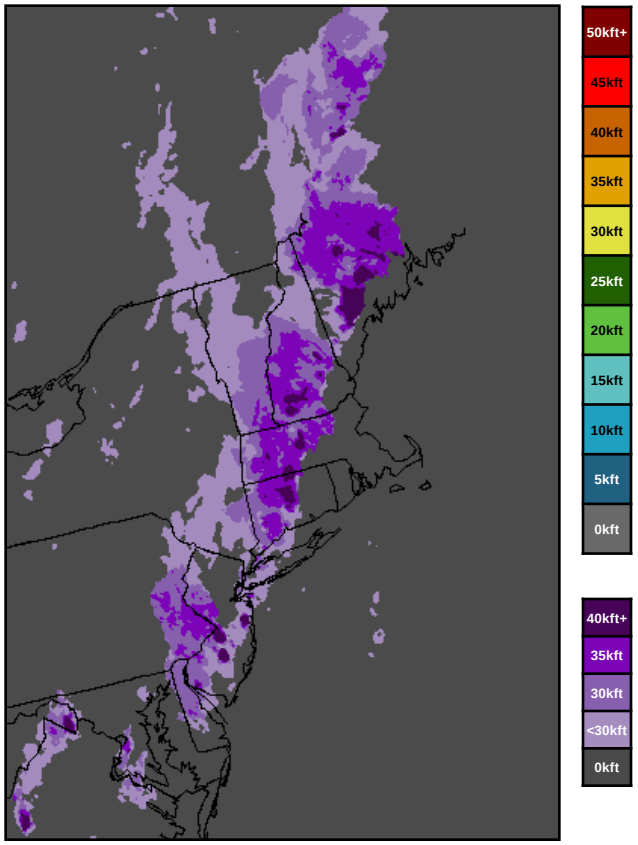
CoSPA Research
Storm Decay



Truth Echo Tops



Existing Echo Tops Forecast



Echo Tops Forecast with Decay

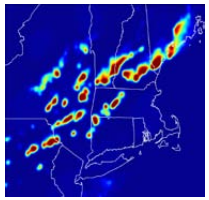
- Uses trends in GC lightning and ET
- Algorithm in testing

CoSPA Research
Motion Estimation

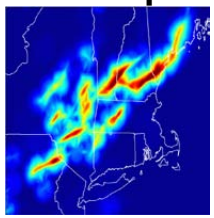
Current Multiscale Approach

Temporal	Spatial
0-30 min	13 km
1-2 hr	69x13 km
2-8 hr	201x101 km

Cell

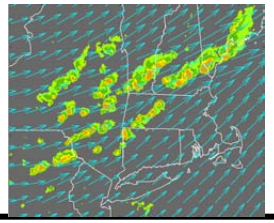


Envelope

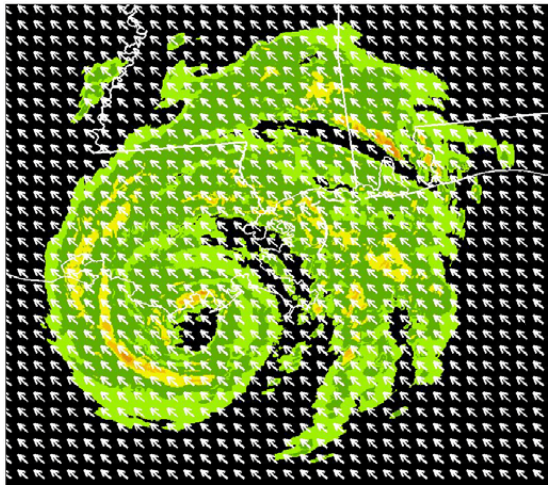


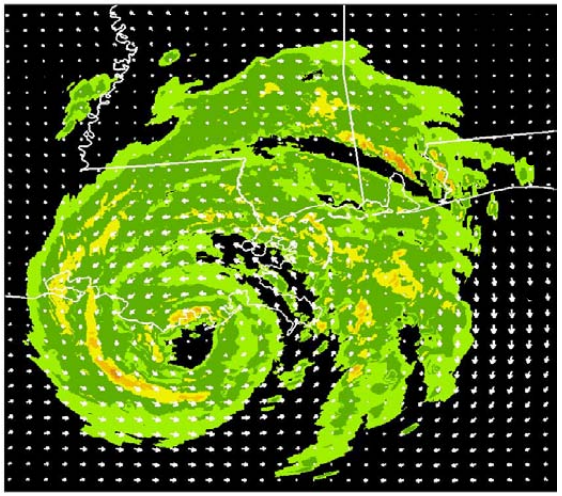
Synoptic

Motion Vectors



Wavelet Approach under Development





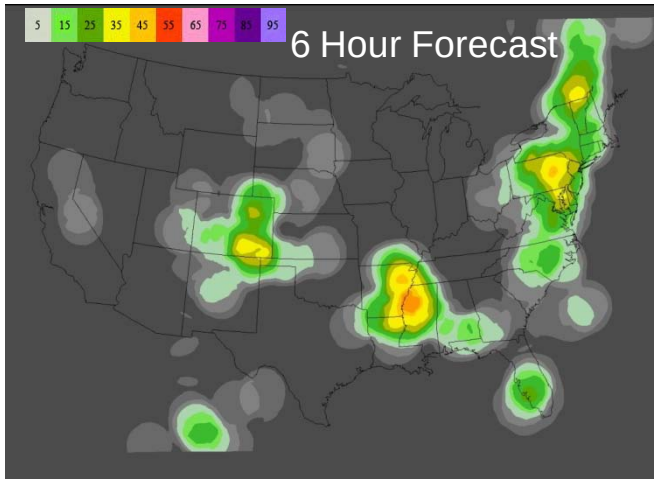
-Translation, rotation, and deformation based on wavelet decomposition

-Applies physical constraints

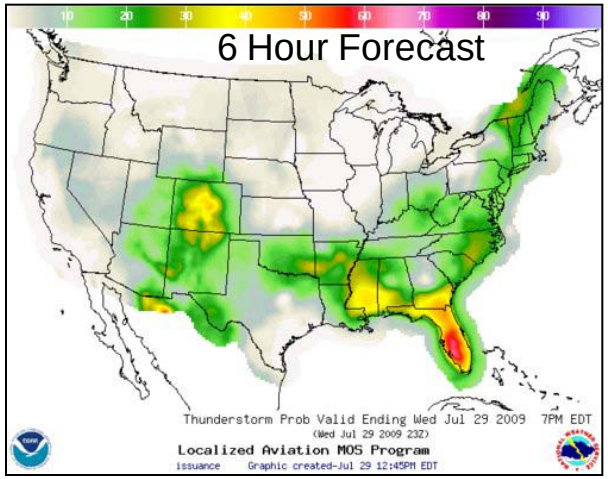
-Algorithm under development

CoSPA Research
Probabilistic Forecasting

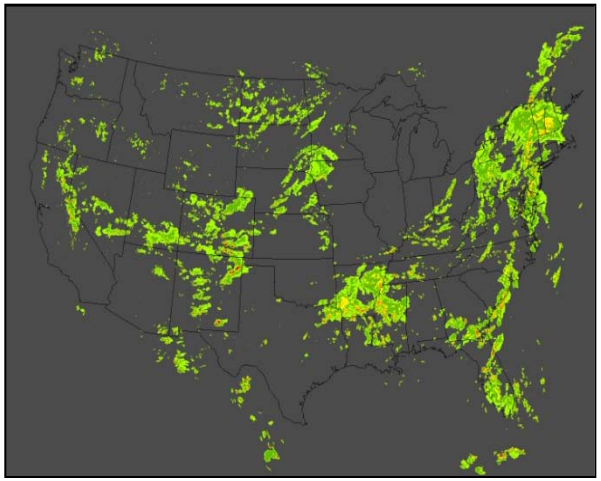
CoSPA



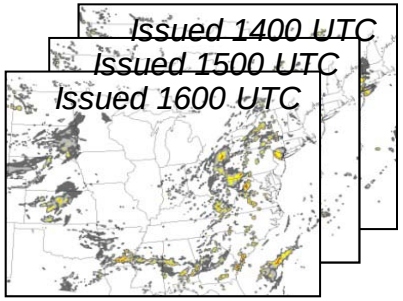
NOAA LAMP



Truth



Time-lagged Ensemble

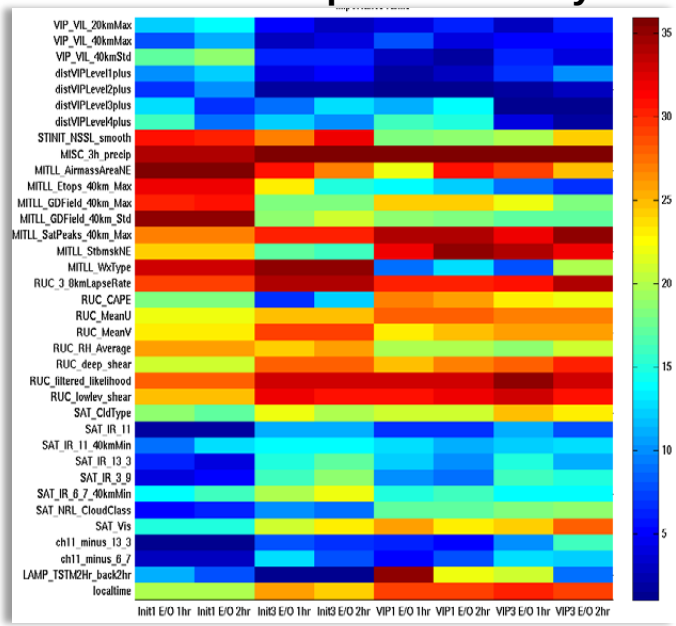


Valid Time – 22 UTC

- **Time-lagged ensemble approach**
- **Based on NOAA RCPF & HCPF**
- **Input is Weather Avoidance Field (WAF), which models pilot behavior in presence of weather**
- **Algorithm running in shadow mode**

CoSPA Research
Probabilistic Forecasting

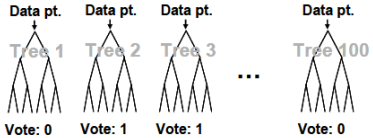
2009 Predictor Importance Analysis



Less Important

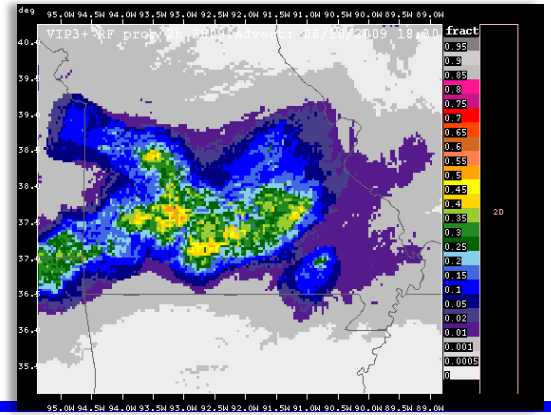
More Important

- Random Forest (RF) consists of an ensemble of weakly-correlated decision trees.

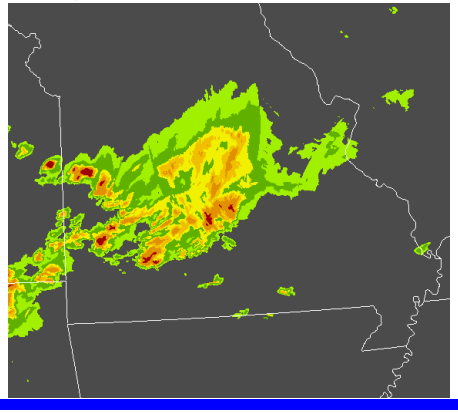


- Use RF to assess value of candidate predictors at different spatial scales, lead-times (0-3 hr) and both convective initiation and growth/decay regimes.
- Created calibrated empirical probabilistic predictive models for VIP 1+, 3+

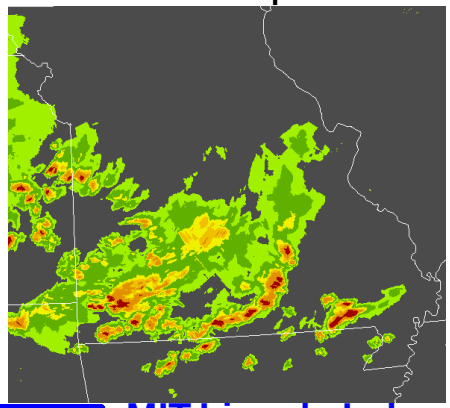
2h RF VIP 3+ probabilistic nowcast



Precip at time RF nowcast made



Observed Precip 2h later



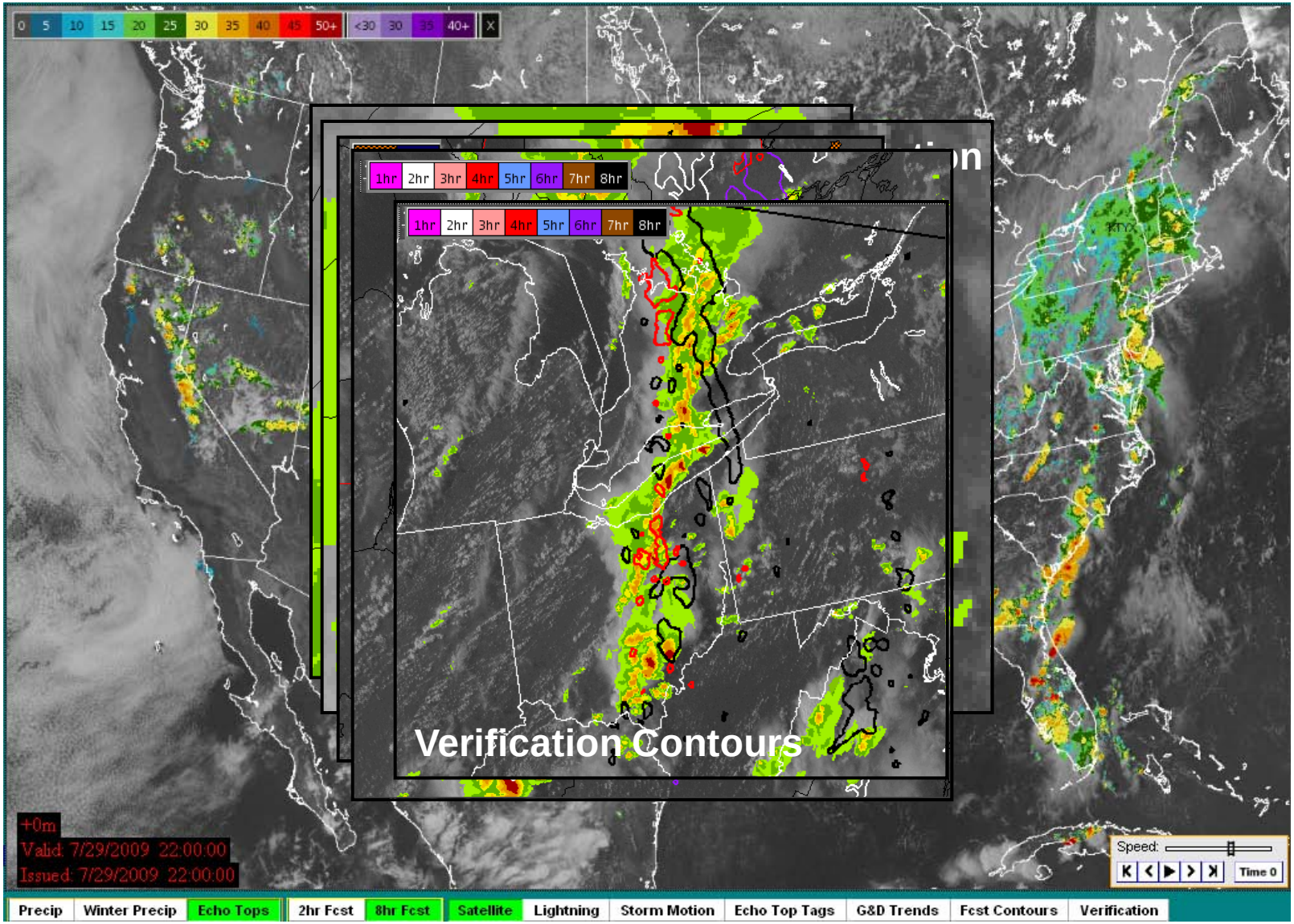
Summary

- **0-8 hr CoSPA Forecast**
  - **Deterministic forecasts of precipitation and echo tops**
  - **Shows storm locations, growth/decay, motion and scale**
  - **Forecasts combine short-term heuristics (CIWS) with longer-term numerical weather prediction (HRRR) modeling**

- **Current Research**
  - **Convective initiation and decay, storm motion, probabilistic forecasts, forecast blending, numerical modeling (HRRR)**
  - **Research collaboration among FAA, MITLL, NCAR, NOAA, and NASA**

Extras

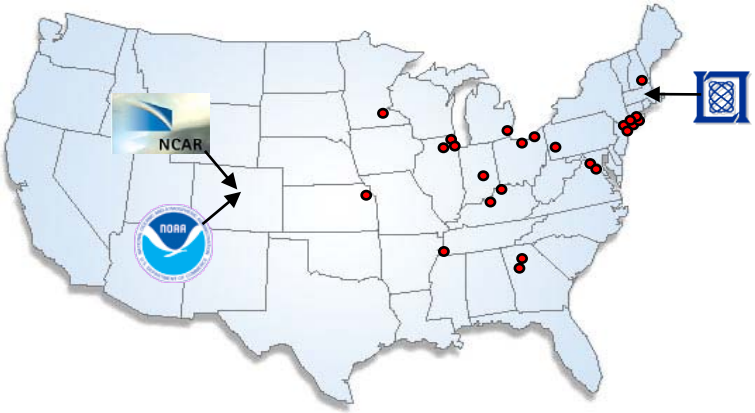
CoSPA Situation Display

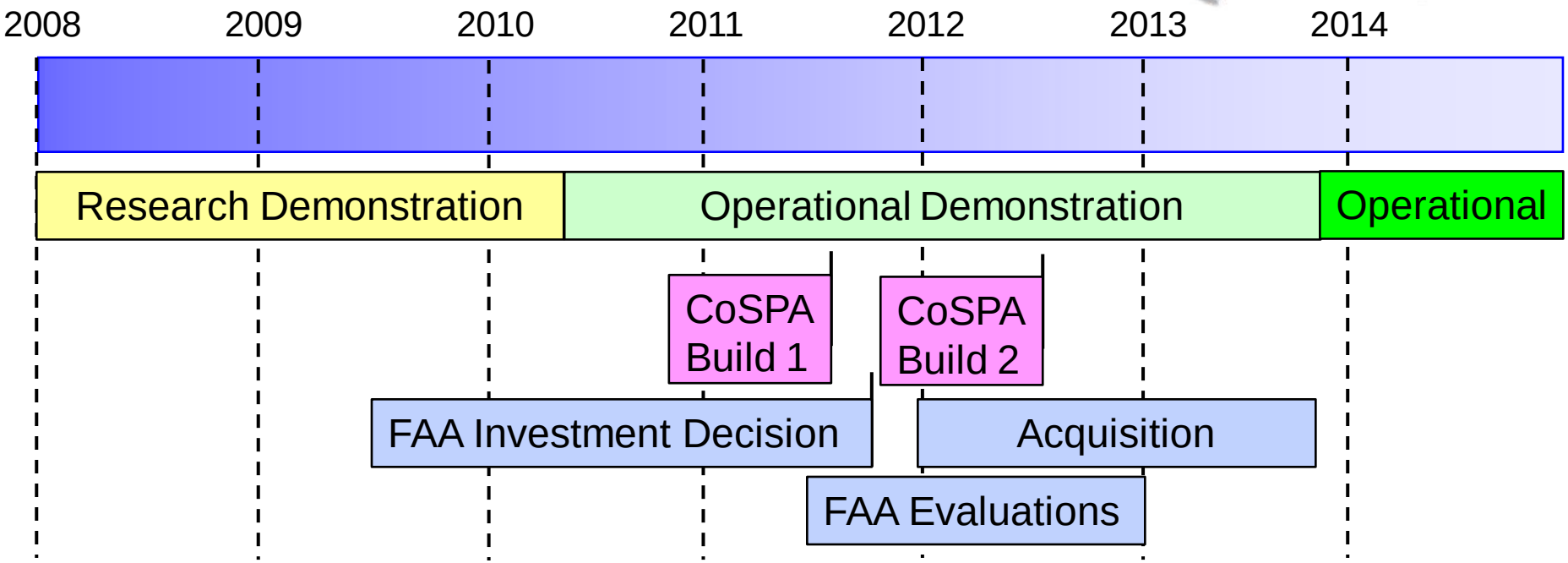


Live Real-time Demonstration in 2010

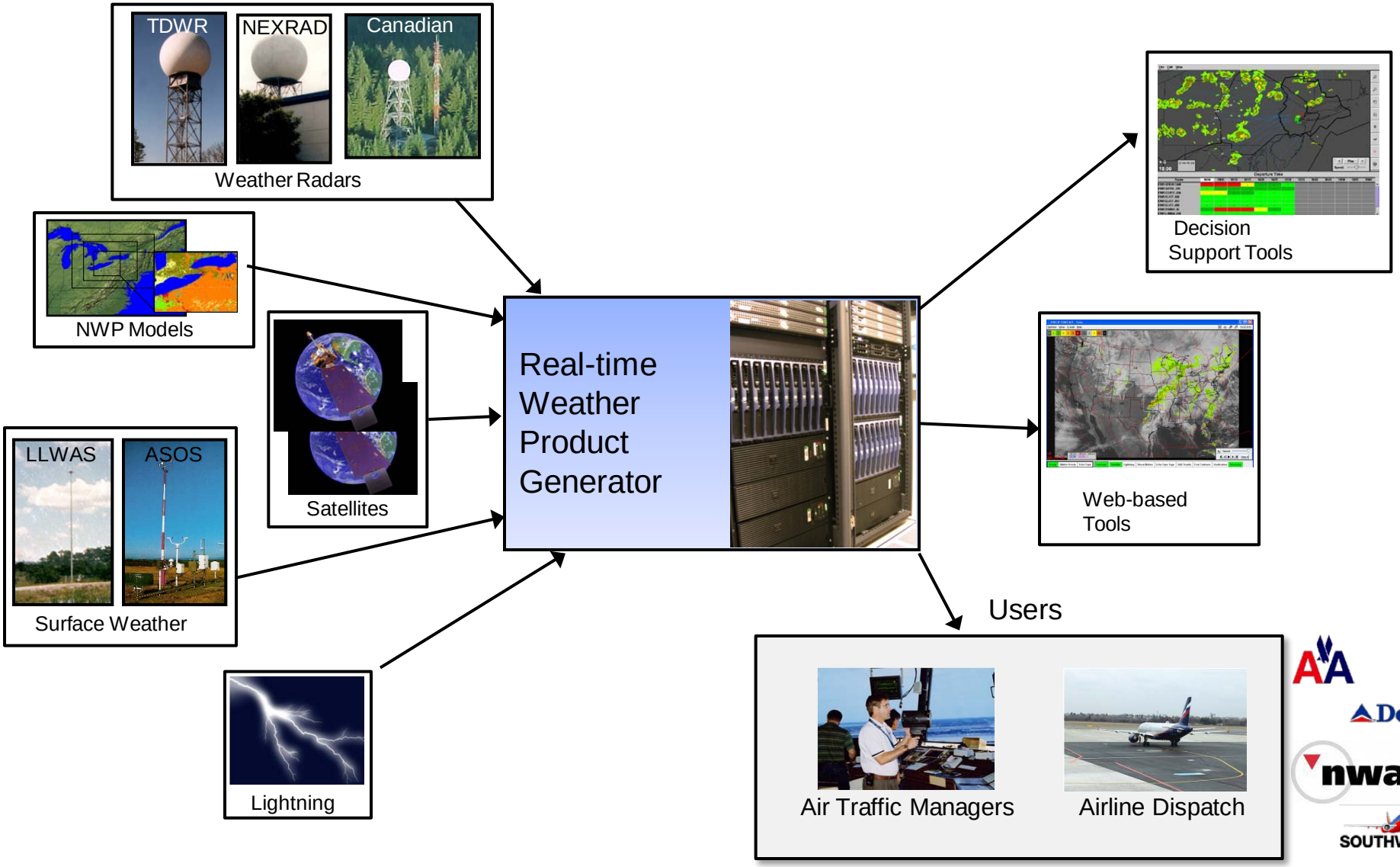
- **Live Forecast Demonstration**
  - **Starts 1 June 2010**
  - **Air Traffic Management Users**
  - **Live 24/7 operations**
- **Goal: Operational by 2013**

CoSPA Operational Sites



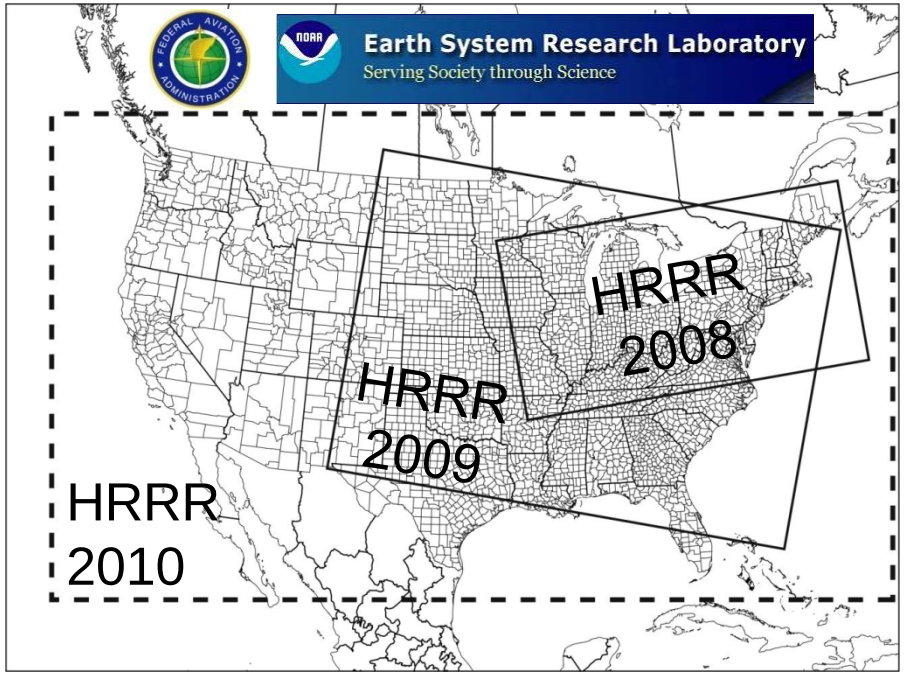


CoSPA Extrapolation Component
Corridor Integrated Weather System



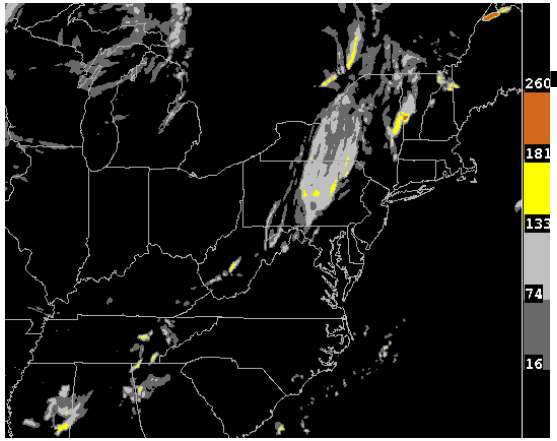
CoSPA Numerical Model Component
High Resolution Numerical Modeling

- **Experimental, High-Resolution, Rapid Refresh (HRRR)**
- **Model re-run every 60 min using latest observations:**
  - **Radar reflectivity**
  - **Aircraft winds and temperatures**
  - **Surface observations**
- **Storm-resolving (3km) model**
- **Rapid update 1 hr**



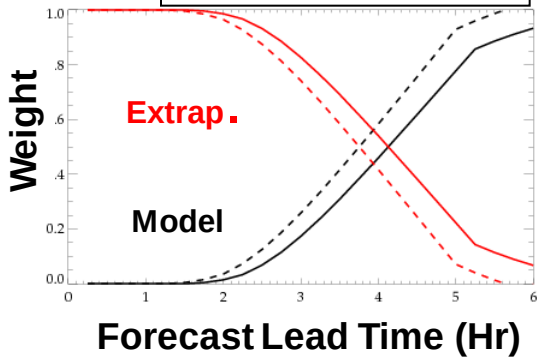
CoSPA Blending Component

Extrapolation Forecast

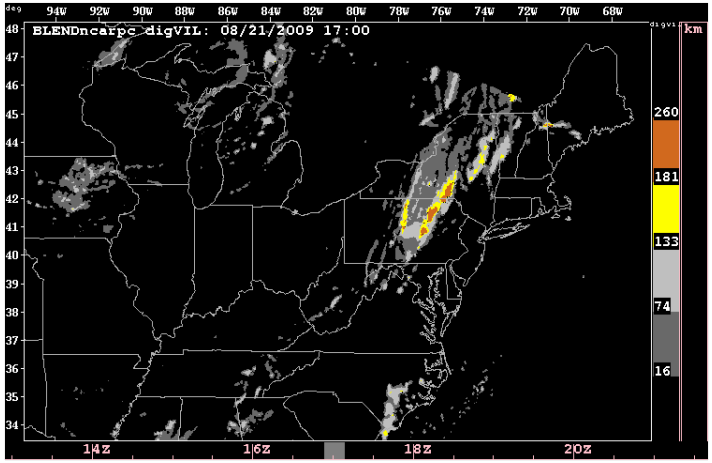


Blending

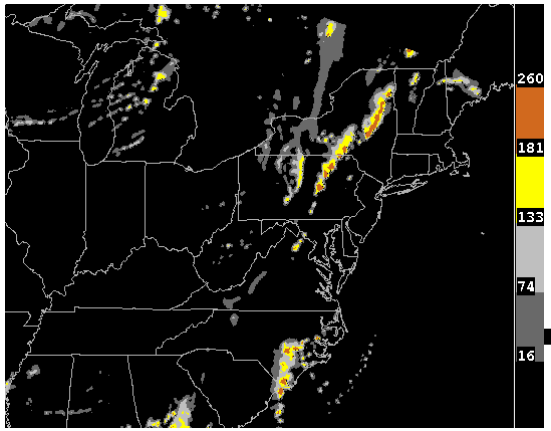
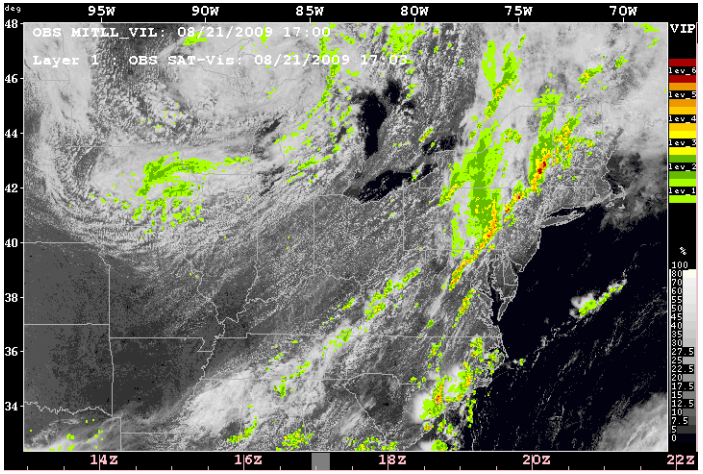
Solid : 15 to 00 Z
Dashed : 00 to15



Blended Forecast



Location Adjusted Model



Truth 17Z